

Proposal Code SC- 2914

X-ray Holography on Single Cells to Observe Cellular Processes

X-ray holographic experiments on single cells were performed on the beamline ID10. We started these experiments on chemically cross linked yeast cells. To create the reference wave a small gold particle was placed in an appropriate distance close to the cell on a silicon nitrite membrane. The holograms were recorded using the coherent beam of ID10.

In the first set of experiments we used gold particles with 1 μm diameter, see Figure 1 A. Care was taken to place the cell and the gold particle in a section of 10 μm x 10 μm , which is the beam size. Evaporated buffer resulted in slight deposit on the membrane, probably salt. We could record X-ray holograms with high intensity, see Figure 1 B. The reconstructions gave the image of the cell, probably with the nucleus in the centre. The resolution of the image was around 1 μm , as determined by the size of the gold sphere. We realized that experiments with smaller gold particles are feasible, and that better sample preparation procedures are needed to avoid any deposits on the membrane.

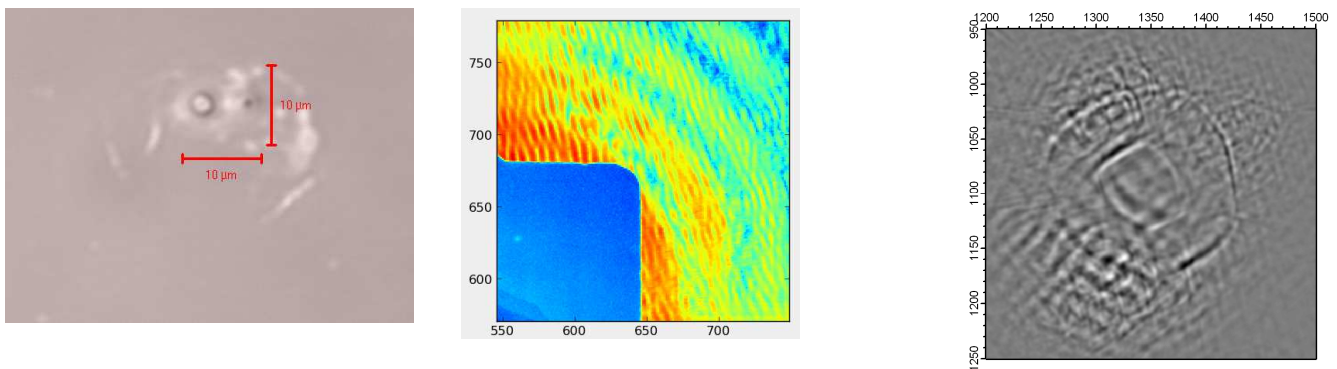


Figure 1 (A): Optical image of a yeast cell and a gold sphere of 1 μm diameter on the silicon nitrite membrane.

(B): Zoom in the X-ray hologram of the yeast cell and 1 μm gold sphere. The modulations which encode the phase information are clearly visible

(C) Reconstruction of the cell. The image is very blurred because of missing information at small angles and by the use of a large 1 μm gold particle.

During a second experiment on ID10 we measured a yeast cell with a 250 nm gold particle (see Figure 2 A). Modified sample preparation procedures were used and extensive care was taken to avoid any contamination of the sample by remaining salts. We could record a X-ray hologram of a yeast cell and a 250 nm gold particle (see Figure 2 B). The obtained reconstruction of the cell is shown in Figure 2 C. However, the reconstruction is very blurred due to strong parasitic scattering caused by the slits of the setup and by missing information at small angles.

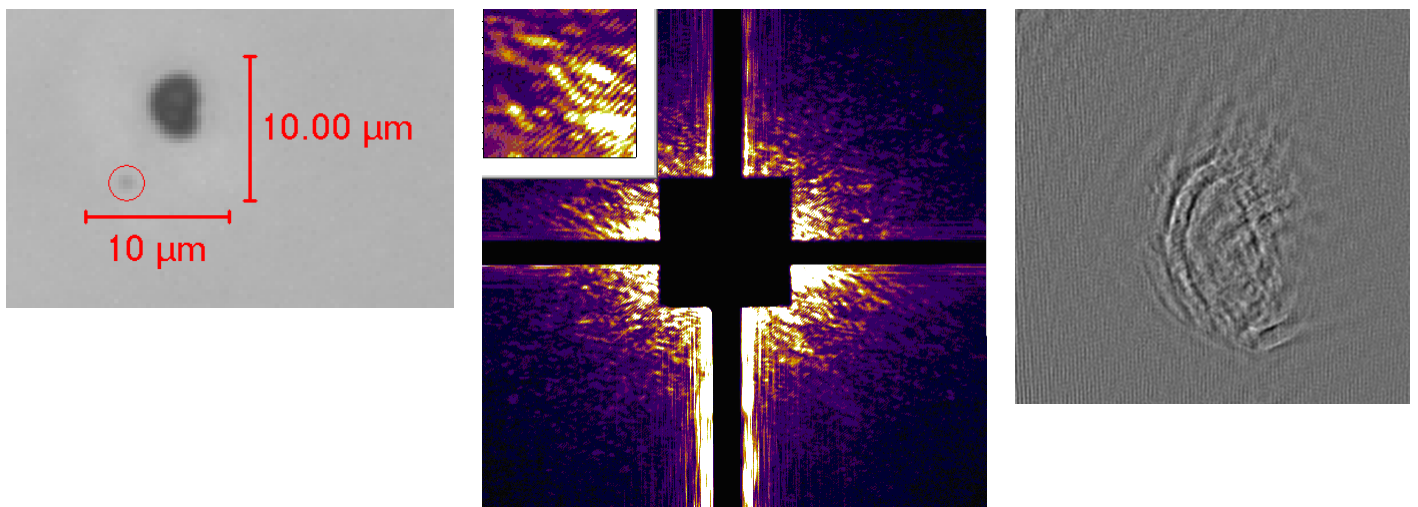


Figure 2: (A) A yeast cell and a gold sphere of 250 nm diameter were placed on a silicon nitride membrane. The red circle indicates the position of the gold sphere. (B) X-ray hologram of the yeast cell and gold sphere measured on ID10 using the old setup. The modulations which encode the phase information are clearly visible. (C) Reconstruction of the cell. The image is very blurred because of the strong streaks close to the mask, and by missing information at small angles.